PJM Distributed Energy Market

Opportunity Study

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2003 Distributed Energy Peer Review
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Bradley W. Johnson
Consultant, Oak Ridge National Laboratory
bwjohnson@acninc.net
703.532.3252
Falls Church, VA

Introduction

- What If DR Could Easily Participate In The Wholesale Markets?
- What If The Multiple Benefit Streams of DR Were Fully Monetized?

PJM DR Market Opportunity Study Overview

- Examine Opportunities for Using DR in Wholesale Power Markets
- Focus on PJM—Arguably, it has the Best Developed Markets
- Quantify DR Revenue Potential
- Identify Wholesale Market Challenges
- Use Choptank Electric Cooperative as a Real World Example

Choptank's Existing DR Program

Choptank Facts
- 43,000 Customers
- 197 MW Peak
- 5,000 + miles of distribution
- 161 Employees

Choptank Electric Cooperative Service Area

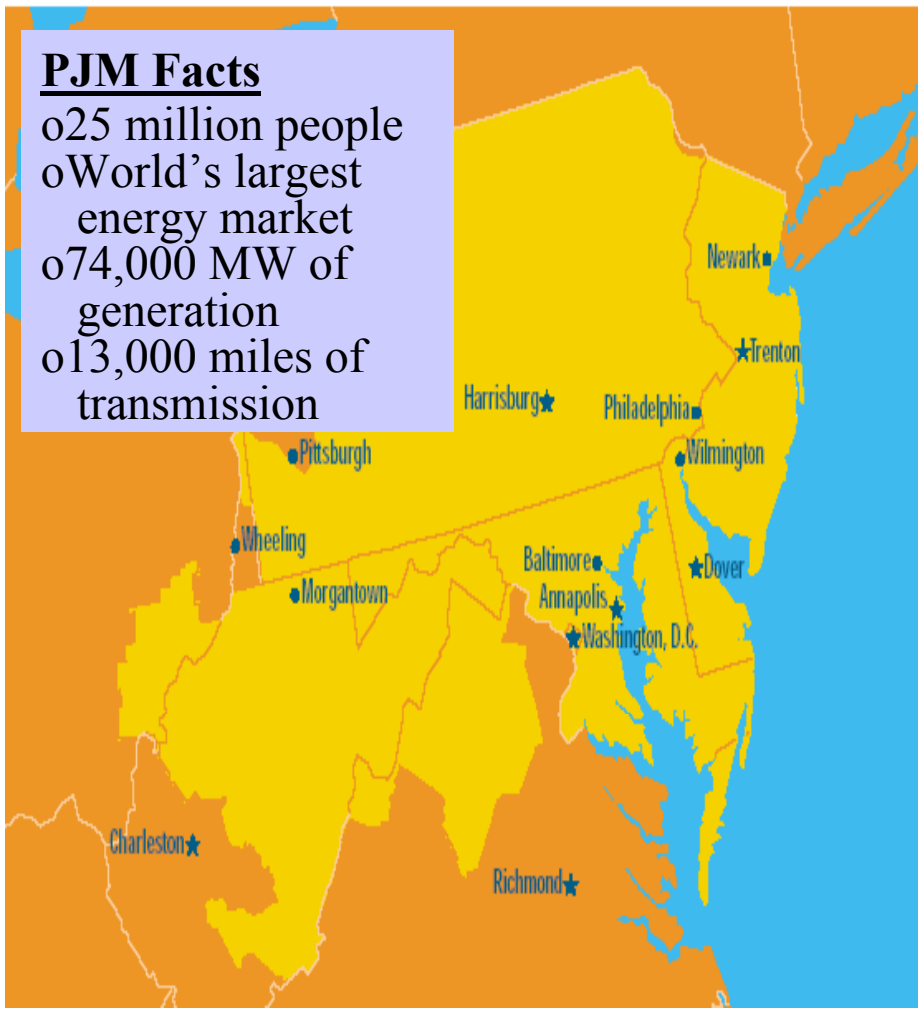
Successful Curtailment Program:

- 400 Poultry Farm Participants
- Average Genset Size - 100 KW
- Choptank Sends Signal
- Farmers Save ~ 30%
- Summer Peak Reduced By ~ 10%
- 50% of Genset Capacity Unused

Future of Program Is Uncertain

The PJM Markets

PJM Control Area



PJM Load Response Programs:

- Emergency Load Response
- Economic Load Response

Other Wholesale Markets:

- Capacity Markets
- Energy Markets
- Ancillary Services
  - oSpinning Reserves
  - oRegulation
  - oBlack Start

Initial Hypothesis—More Benefits in PJM Markets Than Choptank Program

- Choptank located in congested area—high energy value
- Using 100% of capacity would provide large capacity benefit
- Ancillary service benefits—icing on the cake

Key Assumptions

- 2-way power with no incremental cost
- No aggregation costs
- No environmental restrictions operating on diesel
- Able to satisfy all PJM market rules

Key Findings

- In 2002 the PJM markets would have provided less revenue opportunity for DR than Choptank
  - ~ 80% Less from the Load Response Programs
  - ~ 10% Less from the Wholesale Markets
- The PJM markets appear to be working—effectively raising the bar for DR
- The new markets are extremely complex and it has become more difficult to earn what incentive is available
- Aggregation role is critical

2002 DR Benefit Projections

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2002 Revenue Comparisons for Choptank & PJM Market Options
Typical Choptank Cooperative Poultry Farmer With a 100 Kw Genset

	Average Capacity (KW)	Genset Operating Hours (Total/Yr)	Gross Revenues ($/Yr)	Variable Cost (1) ($/Yr)	Net Revenues ($/Yr)	Net (2) Revenue ($/KW/Yr)	% Bill Reduction
Choptank Curtailment Program	32.4	128	$ 3,188	$ 399	$ 2,789	$ 27.89	30.3%
PJM Load Response Program							
--Emergency Response	42.9	7	$ 150	$ 26	$ 124	$ 1.24	1.6%
--Economic Response	32.4	237	$ 1,333	$ 863	$ 470	$ 4.70	5.1%
PJM Wholesale Market Participant							
--Real Time Energy Market	100	274	$ 3,463	$ 2,411	$ 1,052	$ 10.52	11.4%
--Capacity Market (3)	100	--	$ 1,160	--	$ 1,160	$ 11.60	12.6%
--Ancillary Services Market (4)	100	--	$ 282	--	$ 282	$ 2.82	3.1%
Total Wholesale		274	$ 4,905	$ 2,411	$ 2,494	$ 24.94	27.1%

Notes:

(1) Assumes 8.8 cents/KWH

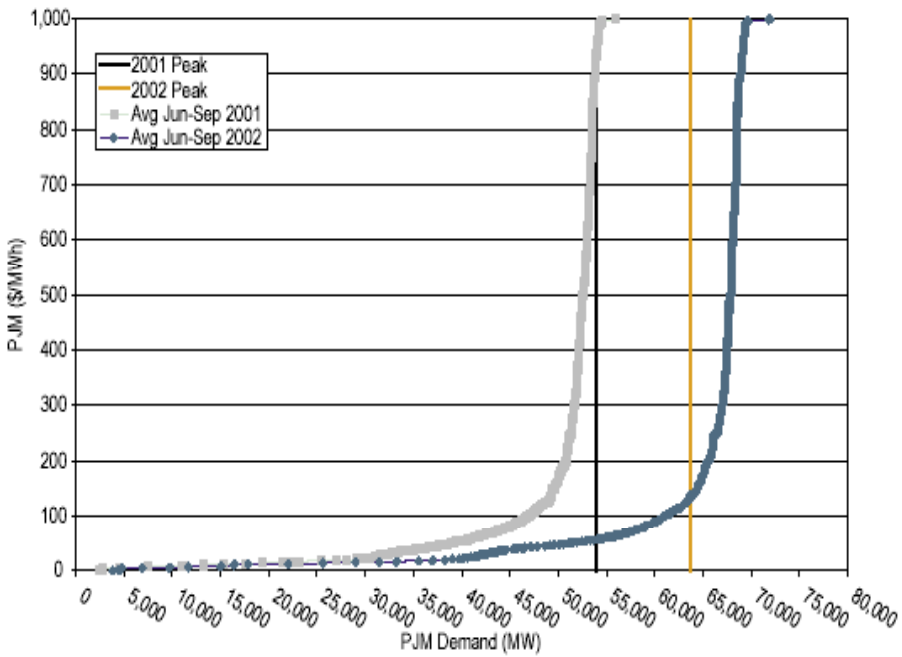
(2) Assuming a 100 KW genset

(3) Weighted average of daily, monthly and multi-month markets

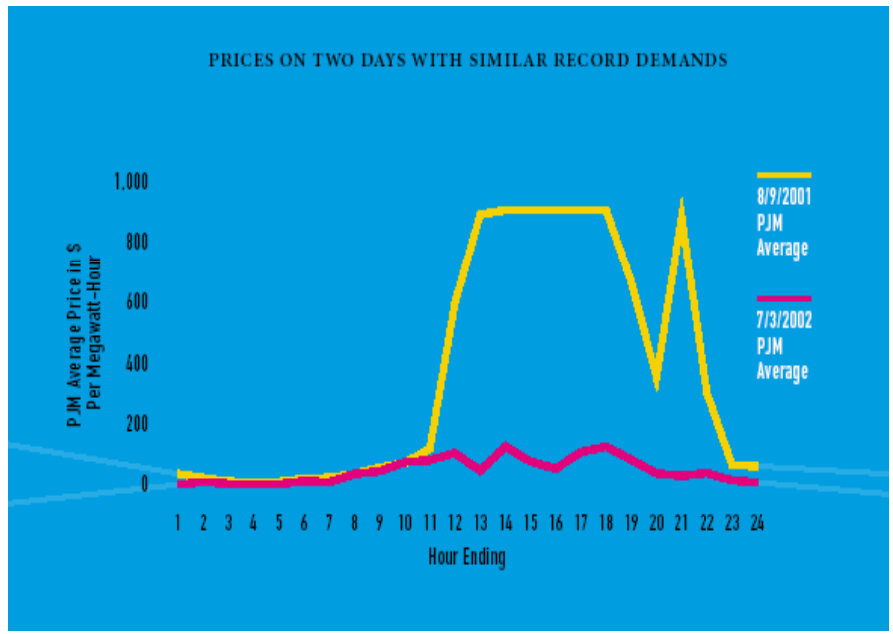
(4) Average for PJM system

PJM Markets Are Working -- Energy

PJM Supply Curves 2001 & 2002

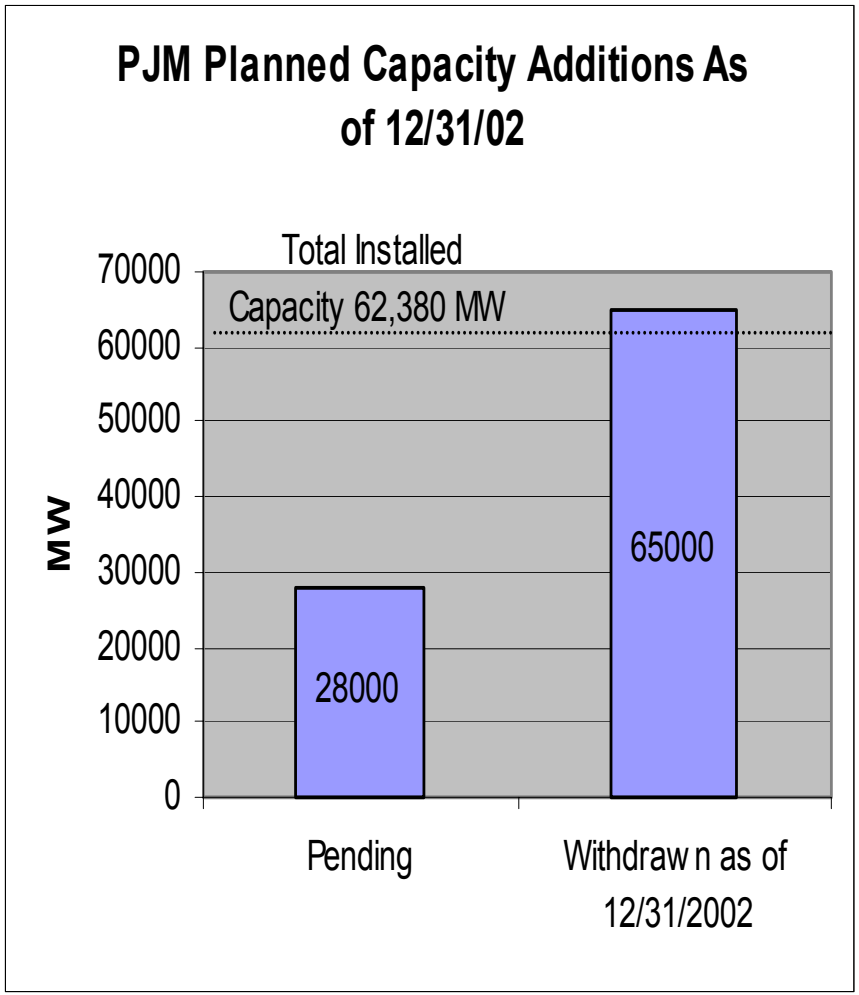


PJM Peak Day LMP Comparisons 2001 & 2002

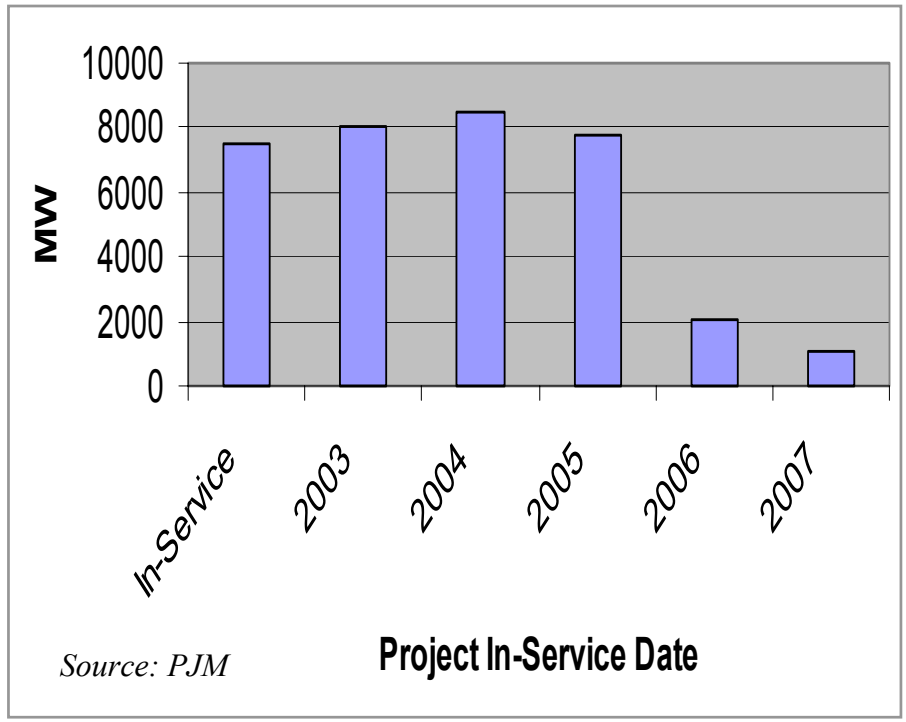


Source: PJM

PJM Markets Are Working -- Capacity



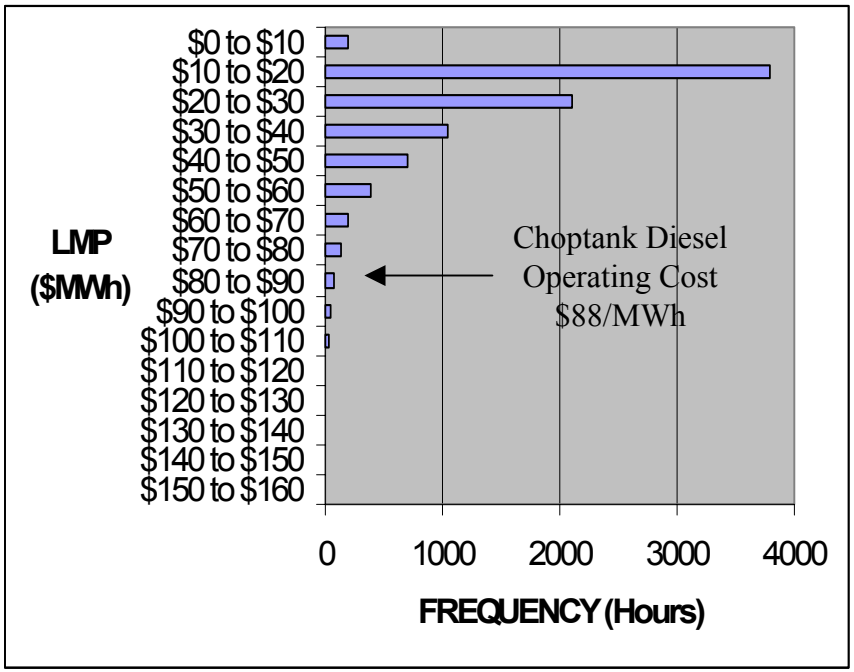
Projected PJM Capacity Additions 2003 - 2007



Source: PJM

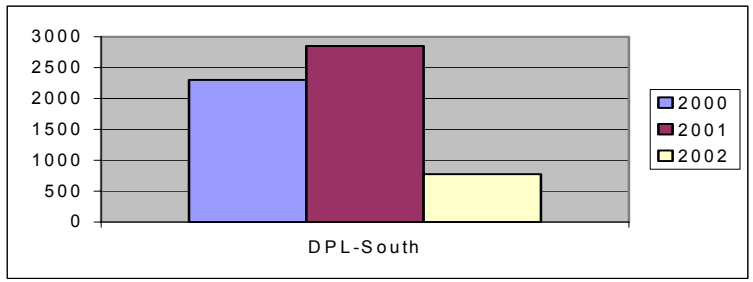
PJM Congestion Prices Are Not Sufficient to Offset High Operating Costs of Generators

2002 Frequency Distribution of Average PJM System LMPs



Source: Derived from PJM data

Total Yearly Hours of Transmission Constraints For the DPL-South Bus 2000-2002



Source: Derived from PJM data

Choptank DR Net Energy Revenues With & Without Congestion

	PJM System Average		DPL-S Aggregate	
	Net Energy Revenue* ($/MW-Year)	Dispatch Hours	Net Energy Revenue ($/MW-Year)	Dispatch Hours
2002	$ 5,611	145	$ 10,520	274

Source: Derived From LMP Data for DPL-South Aggregate and PJM State of the Market Reports 1999-2002

Markets Have Become Very Complex

- Electricity markets are no longer "monolithic" and are no longer defined by an integrated utility's avoided cost
- New market rules are still evolving and are difficult for DR to satisfy
- Wholesale power markets have been volatile making it difficult to forecast revenues
- New market complexities will make the role of an "aggregator" even more critical and may not offer incentives for utilities to participate

Role of "Aggregator"More Critical & More Difficult to Take On

Aggregator Functions

1) Assemble critical mass of customers
2) Manage market transactions
3) Install communications equipment
4) Provide customer care and support functions

Aggregation Challenges

- Difficult to establish critical mass of customers vs. ratepayers
- Customer churn
- Price volatility
- Uncertainty makes it difficult to invest capital

Summary

Conventional Technology Not Sitting Still

- Bar has been raised

Competitive Markets Are Complex

- DR owners may not want to learn requisite skills
- Utilities may not want to continue to "aggregate"

More Challenges Than Opportunities Near-Term

- Price volatility & uncertainty
- Revenue derived from several markets
- Market rules not clear

Implications

DR Technology Needs To:

- Become more efficient
- Become less expensive
- Win acceptance as a replacement for conventional T&D and generation investments

Deployment Will Require:

- 2-way plug-n-play interconnection
- Real time two-way communications
- "Agents" for conducting market transactions
- Incentives & capital